

MARIE

October 2003 Status – Science Data Comments

During October 2003, the MARIE instrument provided radiation data continuously with the usual short breaks due to data download and erase sequences up until Oct. 28 (day 301). At that time, immediately following a 4-hour period in which DSN coverage was unavailable, MARIE's DC-DC converter was found to be well over its temperature limit. MARIE was not responsive to a command to put it into its "Survival+Comm" function and was turned off. Some 12 hours after MARIE was turned off, Odyssey entered safe mode, likely due to the intense solar activity. At the time of this writing (11/4/03), return to nadir-pointing is planned for 11/6 and no timetable has been set for troubleshooting MARIE.

The MARIE problem occurred less than 4 hours after the onset of a huge solar particle event (SPE) which began near 11:00 UT on day 301. Figure 1 shows GOES11 proton fluxes for this time period, and the continuation of high fluxes into early November. On day 301, Odyssey lacked DSN coverage from about 11:00 to 16:00 UT, and when coverage was restored, the DC-DC converter temperature problem was noticed immediately. It is impossible, to determine the exact time at which the problem started, but indications of high temperature began at about 14:30 UT. The day 301 SPE was the second major eruption within 48 hours. The earlier event began about 18:00 UT on day 299 and MARIE successfully recorded most of it. This event did not fully subside when the subsequent second event occurred.

Prior to the day 299 SPE, the average measured dose rate was 22.5 ± 4 mrad/day as measured by the A1 counter and 22.6 ± 4 mrad/day as measured by A1-A2 coincidence data. The uncertainties in the dose rates reflect the present state of our understanding of the instrument properties (geometry factor, trigger threshold, etc.) that go into the normalization factors used to convert count rate to dose rate. The science team continues working to understand and reduce these uncertainties. MARIE dose-rate data are shown in Figure 2, up to the last data downloaded prior to the instrument being turned off. The model predicted dose rate for the month of October 2003 was 19.52 mrad/day within 15% of the MARIE measurements.

The SPEs during this time are of particular scientific interest, as Earth and Mars are both magnetically connected to the same region of the sun. This occurs only when Mars lags Earth slightly, as was the case throughout October. Differences in fluxes observed at Earth and Mars will provide a direct measurement of the "radial gradient," i.e., the falloff of intensity with distance from the Sun. Thus the data from day 299-300 are expected to be of considerable value. With the inclusion of the MARIE measured SPE data (October 26-28), the dose-rate for the month of October 2003 is 33.4 ± 4 mrad/day

The average Earth-Sun-Mars angle during October 2003 was about 16.8° with Earth at 1.4 AU and Mars at 1.0 AU. On October 26th the Earth-Sun-Mars angle was about 20.5° .

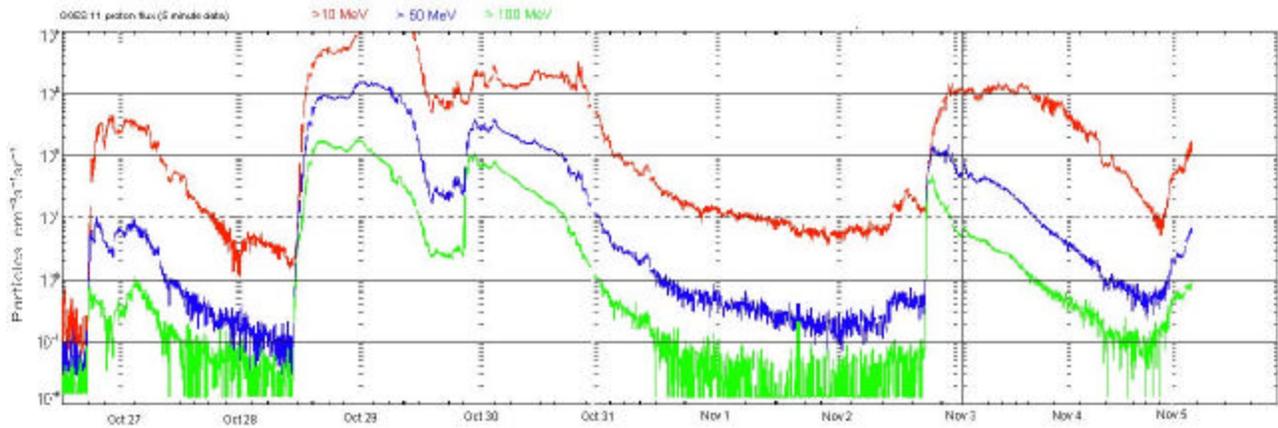


figure-1: GOES 11 data for the period from late October to early November 2003. The event that began on October 28th is considered to be the third largest recorded SPE during the past 30 years.

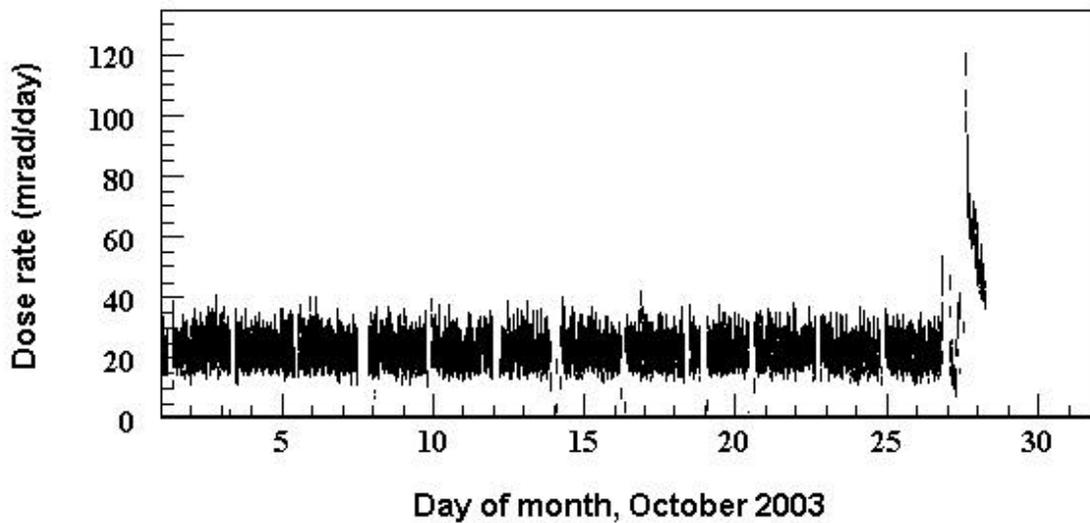


Figure-2: Radiation dose-rate from GCR and SPE contribution during October 2003. The data shown is from the A1-A2 coincidence data. Note that the maximum dose-rate is shown is only up to 120 mrad/day. For complete SPE contribution see Figure-3.

October 2003: Model Calculations vs. MARIE Measurements

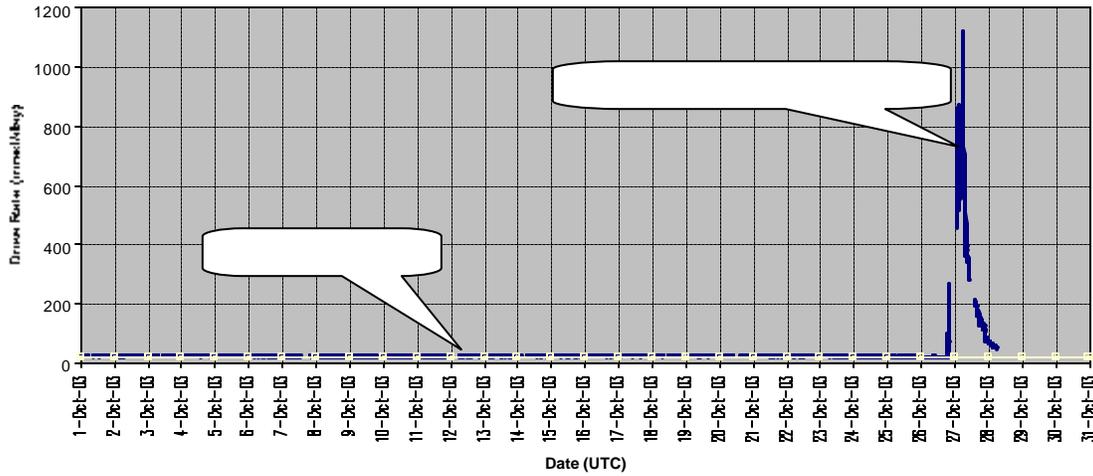


Figure-3: Radiation dose-rate from the GCR contribution in the Martian orbit during October 2003. Dose-rate (mrads/day) measurements from MARIE (blue discrete line) are shown along with the model predictions (yellow dotted line). The average dose-rate is within 15% of the model predictions. Also, see Figure 4.

October 2003: Model Calculations vs. MARIE Measurements

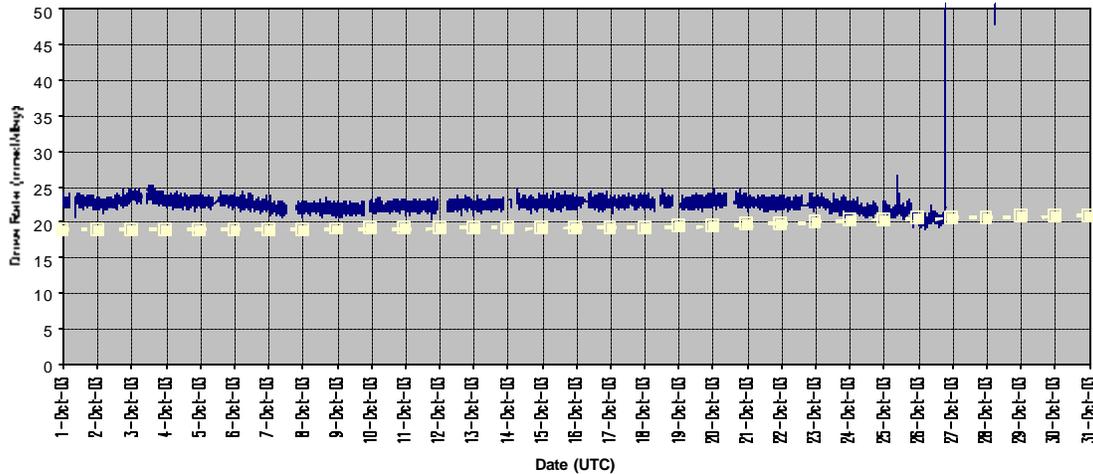


Figure-4: (Close-up view of Figure 3) Dose-rate (mrads/day) measurements from the MARIE instrument (blue discrete line) are shown along with the model predictions (yellow dotted line). In September 2003, short-term GCR modulations of the MARIE measurements observed at the model predicted time but in the opposite direction. Similarly, in October 2003, short-term modulation of GCR variation showed the trend in the opposite direction. Also, see Figure-5.

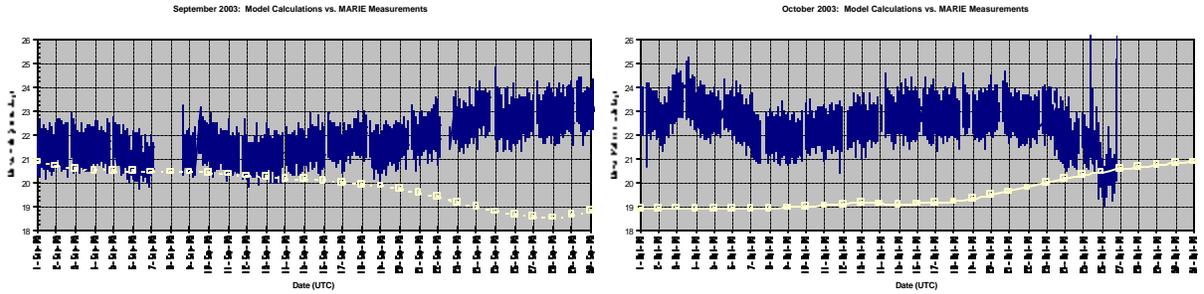


Figure-5: Close-up views of model calculations and MARIE measurements during September and October 2003. Model predicted variations in the GCR environment showed consistency but in the opposite direction of the MARIE measurements. Science team is further investigating this observation.

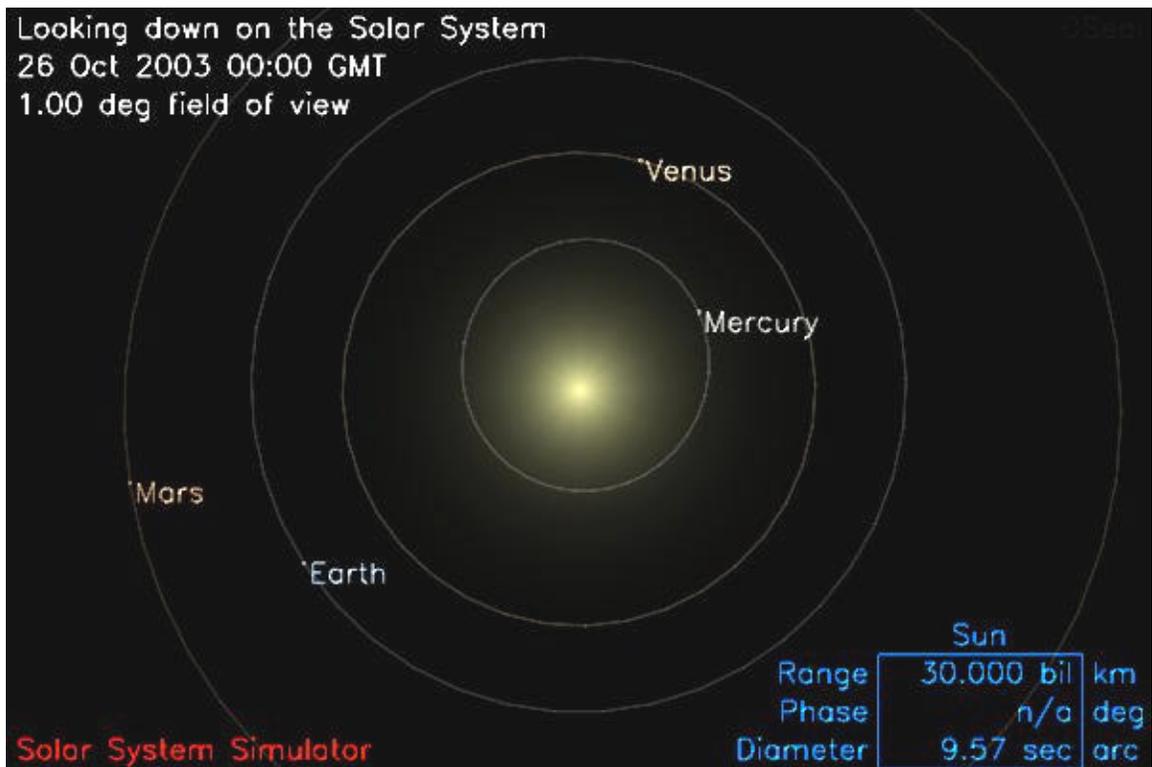


Figure-6: Orientation of Earth-Sun-Mars on October 26th. The angle between Earth-Mars-Sun is about 20.5°.